FORM PTO-1390 (Rev 5-93) U.S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: **ZAHFRI P420US**

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S APPLICATION NO. (If known, see 37 C.F.R.1.5): 10/088313

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/09067	**September 16, 2000**	**September 22, 1999**

TITLE OF INVENTION

FINAL DRIVE FOR DRIVING A VEHICLE WHEEL

APPLICANT(S) FOR DO/EO/US

Max BACHMANN

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ■ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ■ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ■ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ■ has been transmitted by the International Bureau. (PCT/IB/308 mailed **29 March 2001**).
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ■ A translation of the International Application into English (35 U.S.C. 371(c)(2)) is attached.
7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ■ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ■ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ■ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 with PTO FORM 1449.
12. ■ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ■ A FIRST preliminary amendment w/Marked-Up Version of Amended Specification.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ■ Other items or information:

- ■ Preliminary Examination Report
- ■ Annexes to Pre. Ex. Rep.
- ■ International Search Report
- ■ German Novelty Search Report
- ■ 8 copies of citations
- ■ Form PCT/IB/308
- ■ International Publ. No. **WO 01/21427 A1** (Face page only)
- ■ Copy of Request
- ■ Submission of Formal Drawings
- ■ 2 sheets of formal drawings
- ■ Abstract
- ■ German Language Specification
- ☐

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date **March 14, 2002** in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number **EL 918840040 US** addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Anthony G. M. Davis
(typed or printed name of person mailing paper)

Anthony G.M. Davis
(signature of person mailing paper)

PATENT & TRADEMARK OFFICE
020210

17. ■ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO $890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)). $740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	890	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	0	

Claims	Number Filed	Number Extra	Rate		
Total Claims	14. - 20 =	0	x $18.00	0	
Independent Claims	1 - 3 =	0	x $84.00	0	
Multiple dependent claim(s) (if applicable)			+ $280.00	0	
			TOTAL OF ABOVE CALCULATIONS =	890	
Reduction by 1/2 for filing by small entity, if applicable. **Applicant claims Small Entity Status.** (Note 37 CFR 1.9, 1.27, 1.28).				0	
			SUBTOTAL =	890	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	0	
			TOTAL NATIONAL FEE =	0	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property			+	40	
			TOTAL FEES ENCLOSED =	930	
				Amount to be: refunded	$
				charged	$

a. ■ A check in the amount of $ **930.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 04-0213 in the amount of $____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-0213. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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PATENT & TRADEMARK OFFICE

020210

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10/088313
JC10 Rec'd PCT/PTO 14 MAR 2002

03/14/02

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Max BACHMANN
Serial no.	:	
For	:	FINAL DRIVE FOR DRIVING A VEHICLE WHEEL
Docket	:	ZAHFRI P420US

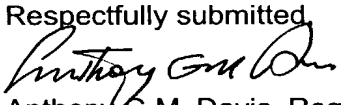
BOX PCT
The Commissioner of Patents and Trademarks
Washington, D.C. 20231

SUBMISSION OF FORMAL DRAWINGS

Enclosed please find two (2) sheets of formal drawings which are to be entered in this case.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,



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03/14/02 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Max BACHMANN
Serial no.	:	
For	:	FINAL DRIVE FOR DRIVING A VEHICLE WHEEL
Docket	:	ZAHFRI P420US

BOX PCT
The Commissioner of Patents and Trademarks
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Dear Sir:

By way of preliminary amendment, please amend the above identified application as set forth below.

In the Specification:

Please cancel paragraphs 2, 3, 4, 8, 9, 12, 13, and 16 of the specification, in their entirety, in favor of a clean form of paragraphs 2, 3, 4, 9, 12, 13 and 16 of the specification, without any markings thereon, as follows. Accompanying this response is a copy of the original paragraphs of the specification which show the addition(s) (by underlining, highlighting and bold) and the deletion(s) (by strikeout) to the canceled specification paragraphs. Please enter the replacement specification paragraphs into the record of this case.

In the Claims:

Please cancel claims 1-15, without prejudice or disclaimer of the subject matter therein, in favor of new claims 16-29 as follows.

[002] FIELD OF THE INVENTION

[003] The invention relates to a final drive of a vehicle wheel.

[004] BACKGROUND OF THE INVENTION

[009] SUMMARY OF THE INVENTION

[012] BRIEF DESCRIPTION OF THE DRAWINGS

[013] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[016] DETAILED DESCRIPTION OF THE INVENTION

16. (NEW) A final drive to drive a vehicle wheel having a drive motor (1) having an axial extent not coaxially situated relative to a wheel axle and which via reduction steps (3, 11) drives a wheel which can be braked by a braking disk (15) situated within a wheel rim (12) of the wheel and appertaining actuation mechanisms, wherein said reduction steps (3, 11) are disposed directly adjacent and a brake disk (15) is placed between said drive motor (1) and said reduction steps (3, 11) and the axial extension of said drive motor (1) being limited by the brake disk (15) and an actuation mechanism (23) of said brake.

17. (NEW) The final drive according to claim 16, wherein a wheel bearing (13) for absorbing the wheel forces is situated radially outside a first reduction step (3).

18. (NEW) The final drive according to claim 16, wherein a wheel bearing (13) for absorbing the wheel forces is situated in the axial extension are of the said first reduction step (3).

19. (NEW) The final drive according to claim 16, wherein a mounting pad (6) of said drive motor (1) is situated on said reduction steps (3, 11) in the area of a active load line (7) of the wheel.

20. (NEW) The final drive according to claim 16, wherein the radial forces act upon a housing (4) of said drive motor (1).

21. (NEW) The final drive according to claim 16, wherein said drive motor (1) has an air gap and is an electromotor with an active length similar to the diameter of the air gap.

22. (NEW) The final drive according to claim 17, wherein a seal (8) is situated between a hub carrier (5) and the wheel hub (9) of the radial extension of the brake disk.

23. (NEW) The final drive according to claim 22, wherein a non-rotatably retained part (14) of a second of the reduction steps (11) is connected with a non-rotatably retained hub carrier (5) which is in operative connection with said wheel bearings (13) so that by attaching a non-rotatably retained part (14) of said second reduction step (11) with said hub carrier (5), said wheel bearing (13) is fastened upon said hub carrier (5).

24. (NEW) The final drive according to claim 16, wherein a wheel hub (9) has fins (15) which upon rotation of said wheel hub (9) set in motion the medium surrounding said wheel hub (9) and cools said brake (15) and/or said final drive.

25. (NEW) The final drive according to claim 16, wherein a drive motor (1) is hydraulically cooled.

26. (NEW) The final drive according to claim 16, wherein a ring gear (14) of the second reduction step (11), a non-rotatably retained hub carrier (5), a wheel bearing (13) and a seal (18) are combined to form one unit.

27. (NEW) The final drive according to claim 16, wherein an input shaft (2) of one reduction step (3) has a winding recess which upon rotation of said input shaft (2) delivers lubricant.

28. (NEW) The final drive according to claim 17, wherein an input pinion of the reduction step (3) is in intermeshing connection with said ring gear and at least two intermediate wheels.

29. (NEW) The final drive according to claim 17, wherein in that a wheel bearing (13) is designed as skewed bearing in 0-arrangement.

REMARKS

Accompanying this response, please find marked-up paragraphs of the specification which overcome some informalities noted in the specification. The undersigned avers that the enclosed replacement paragraph(s) of the specification do not contain any new matter.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

[001] FINAL DRIVE FOR DRIVING A VEHICLE WHEEL

[002] **FIELD OF THE INVENTION**

[003] The invention relates to a final drive of a vehicle wheel ~~according to the kind defined in detail in claim 1.~~

[004] **BACKGROUND OF THE INVENTION**

[005] Final drives for driving a vehicle wheel are mainly used in low-platform buses where each driven wheel of the vehicle has its own drive motor. To obtain a sufficient rear width it is needed to keep as low as possible the axial expansion of the final drive.

[006] In DE 197 09 570 A1 has been disclosed an electric single final drive having several motors in which several motors are not disposed coaxially to the wheel axle and via a first reduction gear drive a second reduction gear, the output of which acts upon the drive wheel. Between the first reduction step and the second reduction step a wheel bearing is situated the same as a brake disk which is located additionally within the extension of the wheel rim of a twin-tire drive wheel. By both reduction gears being disposed separate from each other by the wheel bearing thereoccurs, chiefly in helical-cut toothed wheels due to the displacement action of the reduction gear, a shift of the oil level which disadvantageously acts upon the lubrication of a reduction step. In order compactly to design the final drive in its axial extension and make it possible to prepare the required torque, several electrical drive motors have to be used.

[007] The problem on which this invention is based is to provide a final drive for driving a vehicle wheel which is compactly designed in axial extension and in which the brake is situated in a wheel rim, only one drive motor is used for each final drive, the reduction gear is sufficiently lubricated and that stands out by a good degree of efficiency.

[008] ~~The problem is solved with a final drive according to the preamble of the main claim and also including the features thereof.~~

[009] **SUMMARY OF THE INVENTION**

[010] According to the invention the final drive can be decelerated via a brake located within the axial extension of a wheel rim, it being possible that the wheel rim be also a rim for a single tire and in which the brake is placed between the drive motor and the reduction steps. By the reduction steps being disposed directly adjacent, all the moved parts of the toothing can be lubricated by one lubricant which is located within a common space where the reduction steps are placed. Hereby a uniform temperature level results which by virtue of the arrangement of the reduction gear upon the wheel outer side can satisfactorily radiate heat to the environment. The drive motor is not situated coaxially to the wheel axle whereby between wheel rim and drive motor an installation space results where can be placed the brake and the actuation mechanism thereof. The wheel bearing is preferably disposed for absorbing the wheel forces radially above the first reductio gear so that the axial installation space needed b the wheel bearing is available to the drive motor. Thereby the drive motor can be designed with a maximum active length preferably similar or equal to the diameter of the air gap without the total length of the final drive being enlarged thus increasing the degree of efficiency of the drive motor. By the wheel bearing being situated in radial direction outside the first reduction step but being located in the radial extension area of the first reduction step, it is possible to connect the wheel hub, one part of the second reduction step and the bearing flange with the wheel bearing to form a compact unit which also has not to be separated even when disassembling the wheel drive whereby during an assembly in case of servicing the wheel bearing has not to be adjusted again. The second reduction step is preferably designed as planetary gear wherein the planet carrier of the planetary gear forms the output, the ring gear is connected with the hub carrier which carries the wheel bearing and the inner central wheel forms the input. But it is also possible to design the ring gear as output. The inner central wheel is driven by the first reduction step which is preferably designed so that the ring gear forms the output, an input pinion forms the input, which is in intermeshing connection with the ring gear and at least two intermediate wheels, and the carrier which holds the intermediate wheel in

stands out by a compact construction, where a drive motor with optimum degree of efficiency can be used and the reduction steps are sufficiently lubricated.

~~[012]~~

~~[013] Other features are to be understood from the description of he figures which show~~

[012] BRIEF DESCRIPTION OF THE DRAWINGS

[013] The invention will now be described, by way of example, with reference to the accompanying drawings in which:

[014] Fig. 1 is a final drive for driving a vehicle with double-shear planet carrier; and

[015] Fig. 2 is a final drive for driving a vehicle with double-shear planet carrier.

[016] **DETAILED DESCRIPTION OF THE INVENTION**

[017] The drive motor 1 not coaxially situated relative to the wheel axle is preferably an electric drive motor but may also be a hydraulic or pneumatic drive motor and it drives an input shaft 2 preferably passed into the housing 4 of the drive motor 1 of a first reduction step 3. The housing 4 of the drive motor is preferably cooled by water and is connected with a hub carrier 5 via connecting elements. The mounting pad 6 of the drive motor 1 on the hub carrier 5 is located in the area of a load active line 7 where the wheel forces act upon the final drive. By the mounting pad 6 being situated in the area of the active load line 7, so that none or only small torque loads generated by the vehicle weight act upon the elements which connect the hub carrier 5 with the housing 4 of the drive motor 1. The mounting pad 6 can thus be made small in its radial extension, it being possible upon this diameter to place a sealing element 8 between a wheel hub 9 rotating at the rotational speed of the wheel and the hub carrier 5. Since the radial extension of the mounting pad 6 is small the peripheral velocity of the sealing element 8 is also small, which advantageously acts upon the service life of the sealing element 8. The wheel hub 9 is connected with the planet carrier 10 which forms the output of a second reduction gear 11 and with a wheel rim 12. A wheel

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2/PRTS

[001] FINAL DRIVE FOR DRIVING A VEHICLE WHEEL

[002]

[003] The invention relates to a final drive of a vehicle wheel according to the kind defined in detail in claim 1.

[004]

[005] Final drives for driving a vehicle wheel are mainly used in low-platform buses where each driven wheel of the vehicle has its own drive motor. To obtain a sufficient rear width it is needed to keep as low as possible the axial expansion of the final drive.

[006] In DE 197 09 570 A1 has been disclosed an electric single final drive having several motors in which several motors are not disposed coaxially to the wheel axle and via a first reduction gear drive a second reduction gear, the output of which acts upon the drive wheel. Between the first reduction step and the second reduction step a wheel bearing is situated the same as a brake disk which is located additionally within the extension of the wheel rim of a twin-tire drive wheel. By both reduction gears being disposed separate from each other by the wheel bearing thereoccurs, chiefly in helical-cut toothed wheels due to the displacement action of the reduction gear, a shift of the oil level which disadvantageously acts upon the lubrication of a reduction step. In order compactly to design the final drive in its axial extension and make it possible to prepare the required torque, several electrical drive motors have to be used.

[007] The problem on which this invention is based is to provide a final drive for driving a vehicle wheel which is compactly designed in axial extension and in which the brake is situated in a wheel rim, only one drive motor is used for each final drive, the reduction gear is sufficiently lubricated and that stands out by a good degree of efficiency.

[008] The problem is solved with a final drive according to the preamble of the main claim and also including the features thereof.

[009]

[010] According to the invention the final drive can be decelerated via a brake located within the axial extension of a wheel rim, it being possible that the wheel rim be also a rim for a single tire and in which the brake is placed between the drive motor and the reduction steps. By the reduction steps being disposed directly adjacent, all the moved parts of the toothing can be lubricated by one lubricant which is located within a common space where the reduction steps are placed. Hereby a uniform temperature level results which by virtue of the arrangement of the reduction gear upon the wheel outer side can satisfactorily radiate heat to the environment. The drive motor is not situated coaxially to the wheel axle whereby between wheel rim and drive motor an installation space results where can be placed the brake and the actuation mechanism thereof. The wheel bearing is preferably disposed for absorbing the wheel forces radially above the first reductio gear so that the axial installation space needed b the wheel bearing is available to the drive motor. Thereby the drive motor can be designed with a maximum active length preferably similar or equal to the diameter of the air gap without the total length of the final drive being enlarged thus increasing the degree of efficiency of the drive motor. By the wheel bearing being situated in radial direction outside the first reduction step but being located in the radial extension area of the first reduction step, it is possible to connect the wheel hub, one part of the second reduction step and the bearing flange with the wheel bearing to form a compact unit which also has not to be separated even when disassembling the wheel drive whereby during an assembly in case of servicing the wheel bearing has not to be adjusted again. The second reduction step is preferably designed as planetary gear wherein the planet carrier of the planetary gear forms the output, the ring gear is connected with the hub carrier which carries the wheel bearing and the inner central wheel forms the input. But it is also possible to design the ring gear as output. The inner central wheel is driven by the first reduction step which is preferably designed so that the ring gear forms the output, an input pinion forms the input, which is in intermeshing connection with the ring gear and at least two intermediate wheels, and the carrier which holds the intermediate wheel in

non-turnably retained. By the input pinion being in intermeshing connection directly with the ring gear, the drive motor which drives the input pinion can be situated at a maximum distance from the wheel axle with the result of a sufficient installation space for the brake and the actuation mechanism of the brake. By the input pinion being in intermeshing connection with the ring gear and with at least two intermediate wheels, the torque is distributed on the input pinion with the consequence of an increase in the service life of the input pinion and the first reduction step can thus be compactly designed whereby the diameter of the wheel bearing can be reduced. By the housing of the drive motor transmitting the wheel forces and the mounting pad of the drive motor being located in the area of the load active line on a hub carrier which carries the wheel bearing in which the wheel forces are introduced, the connecting elements of the supporting parts which absorb the wheel forces can be designed smaller in extension , since no additional torque load from a distance to the load active line acts upon the mounting pad and the connecting elements thereof. Hereby the radial extension of the mounting pad of the drive motor housing can be designed so small on the bearing flange that a sealing element can be placed between the non-turnably situated bearing flange and a wheel hub rotating at wheel rotational speed which due to the small radial extension has less peripheral velocities to overcome. The housing of the drive motor can either be connected with an axle bridge or have supporting places on which fastening elements can be situated for fastening the final drive to the vehicle body. Since the drive motor is located on the wheel inner side, the energy can be favorably supplied. Upon the wheel hub fins are preferably situated with upon rotation of the wheel hub set in motion the medium surrounding the wheel hub so that the brake and the final drive are cooled. The housing of the drive motor is preferably flowed through by a coolant which thus cools the drive motor and via the mounting pad of the drive motor also cools the remaining final drive.

[011] A directly adjacent arrangement of the reduction steps and a brake situated between the reduction steps and the drive motor but within the axial and radial extension of a wheel rim create a final drive for driving a vehicle wheel which

stands out by a compact construction, where a drive motor with optimum degree of efficiency can be used and the reduction steps are sufficiently lubricated.

[012]

[013] Other features are to be understood from the description of he figures which show:

[014] Fig. 1 is a final drive for driving a vehicle with double-shear planet carrier; and

[015] Fig. 2 is a final drive for driving a vehicle with double-shear planet carrier.

[016]

[017] The drive motor 1 not coaxially situated relative to the wheel axle is preferably an electric drive motor but may also be a hydraulic or pneumatic drive motor and it drives an input shaft 2 preferably passed into the housing 4 of the drive motor 1 of a first reduction step 3. The housing 4 of the drive motor is preferably cooled by water and is connected with a hub carrier 5 via connecting elements. The mounting pad 6 of the drive motor 1 on the hub carrier 5 is located in the area of a load active line 7 where the wheel forces act upon the final drive. By the mounting pad 6 being situated in the area of the active load line 7, so that none or only small torque loads generated by the vehicle weight act upon the elements which connect the hub carrier 5 with the housing 4 of the drive motor 1. The mounting pad 6 can thus be made small in its radial extension, it being possible upon this diameter to place a sealing element 8 between a wheel hub 9 rotating at the rotational speed of the wheel and the hub carrier 5. Since the radial extension of the mounting pad 6 is small the peripheral velocity of the sealing element 8 is also small, which advantageously acts upon the service life of the sealing element 8. The wheel hub 9 is connected with the planet carrier 10 which forms the output of a second reduction gear 11 and with a wheel rim 12. A wheel bearing 13 supports the wheel hub 9, the ring gear 14, the second reduction step 11, a sealing element 8 and the hub carrier 5 to form a unit which is adjusted only once by the plant and remains complete when the final drive is disassembled for

servicing. On the wheel hub 9 is placed over connecting elements a brake disk 15 by which the wheel hub 9 can be decelerated. The brake disk 15, which is preferably assembled as a divided arrangement but can also be assembled as complete brake disk, is in its axial installation position removed from th sealing element 9 to the extent that a temperature impairment of the brake disk 15 does not occur upon the sealing element 9, on the wheel hub 9 fins are preferably situated with upon rotation of the wheel hub 9 set in motion the medium surrounding the wheel hub 9 so that the brake disk 15 and the complete final drive are cooled. A bearing 17 which supports the inner central wheel 18 of the second reduction step 11 upon the planet carrier 10 rotates only at the differential rotational speed between the inner central wheel 18 and the planet carrier 10 whereby the service life of the bearing is increased. The bearing 17 can also be constructed by an axial thrust plate. If the first reduction step 3 and the second reduction step 11 have a helical-cut design, it is possible to lay out the teeth so that the bearing 17 be free of forces. The housing 4 of the drive motor 1 is preferably connected with an axle bridge 19 but can also be designed with fastening elements for a single-wheel suspension. The first reduction step 3 and the second reduction step 11 are disposed directly adjacent being thus surrounded by a common lubricant whereby the lubrication is ensured for both reduction steps. The wheel bearing 13 is situated radially outside the first reduction step 3 and axially in the area of the first reduction step 3 whereby a very compact final drive can be created. By the wheel bearing 13 being placed radially outside the first reduction step 3 and a taper roller bearing being preferably used on 0-arrangement, a table support of the drive wheel results. The input shaft 2 preferably has on its surface a recess which purposely delivers the lubricant so that the motor bearing 20 remains lubricated. It is also possible eccentrically to design the opening in which the input shaft 2 is situated in order to make available sufficient lubrication to the motor bearing 20. The teeth of the reductions gears 3 and 11 are preferably helical-cut in order to achieve a favorable noise level. The planets 21 of the second reduction gear 11 are floatingly supported whereby the axial length of the final drive is further reduced.

[018] Fig. 2:

A drive motor 1 drives a first reduction step 3 the output of which drives a second reduction step 11 preferably designed as planetary transmission whose planet gears 21 are double-shear supported. The ring gear of the second reduction step 11 can be connected, in a radial direction with the hub carrier 5 either via a screw connection or via safety rings or pins. A rotational speed sensor 22 is placed between the brake disk 15 and the first reduction gear 3. The actuation mechanism 23 of the brake is preferably situated on the side, but it is also possible to actuate the brake via rods outside the wheel.

Reference numerals

1 drive motor
2 input shaft
3 first reduction step
4 housing
5 hub carrier
6 mounting pad
7 load active line
8 sealing element
9 wheel hub
10 planet carrier
11 second reduction step
12 wheel rim
13 wheel bearing
14 ring gear
15 brake disk
16 fins
17 bearing
18 inner central wheel
1 9 axle bridge
20 motor bearing
21 planet gears
22 rotational speed sensor
23 actuation mechanism

Claims

1. Final drive to drive a vehicle wheel having a drive motor (1) not coaxially situated relative to the wheel axle and which via reduction steps (3, 11) drives a wheel which can be braked by a brake (15) situated within a wheel rim (120, characterized in that said reduction (3, 11) are disposed directly adjacent and a brake (15) is placed between said drive motor (1) and said reduction steps (3, 11).

2. Final drive according to claim 1, characterized in that a wheel bearing (13) for absorbing the wheel forces is situated radially outside a first reduction step (3).

3. Final drive according to claim 1, characterized in that a wheel bearing (13) for absorbing the wheel forces is situated in the axial extension are of the said first reduction step (3).

4. Final drive according to claim 1, characterized in that the mounting pad (6) of said drive motor (1) is situated on said reduction steps (3, 11) in the area of a load active line (7) of the wheel.

5. Final drive according to claim 1, characterized in that the radial forces act upon a housing (4) of said drive motor (1).

6. Final drive according to claim 1, characterized in that said drive motor (1) is an electromotor with an active length similar to the diameter of the air gap.

7. Final drive according to claim 1, characterized in that a seal (8) is situated between a non-turnably retained part (5) and the wheel hub (9) of the radial extension of the brake disk.

8. Final drive according to claim 1, characterized in that a non-turnably retained part (14) of a second reduction step (11) is connected with a non-turnably retained hub carrier (5) which is in operative connection with said wheel bearings (13) so that by fastening said non-turnably retained part (14) of a second reduction step (11) with said hub carrier (5) said wheel bearing (13) is fastened upon said hub carrier (5).

9. Final drive according to claim 1, characterized in that a wheel hub (9) has fins (15) which upon rotation of said wheel hub (9) set in motion the medium surrounding said wheel hub (9) and cools said brake (15) and/or said final drive.

10. Final drive according to claim 1, characterized in that a drive motor (1) is hydraulically cooled.

11. Final drive according to claim 1, characterized in that a ring ger (4) of a second reduction step, a non-turnably retained hub carrier (5), a wheel bearing (13) and a seal (18) are combined to form a one unit.

12. Final drive according to claim 1, characterized in that an input shaft (2) of a first reduction step (3) has a winding recess which upon rotation of said input shaft (2) delivers lubricant.

13. Final drive according to claim 1, characterized in that an input pinion of a first reduction step (3) is in intermeshing connection with said ring gear and at least two intermediate wheels.

14. Final drive according to claim 2, characterized in that a wheel bearing (13) is designed as skewed bearing in 0-arrangement.

15. Final drive according to claim 1, characterized in that the axial extension of said drive motor (1) is limited by a brake disk (15) and an actuation mechanism (23) of said brake.

ABSTRACT OF THE DISCLOSURE

A brake (15) is arranged between a drive motor (1) and reduction steps (3, 11). By arranging the reduction steps (3, 11) directly adjacent to one another, a uniform temperature level is established and the reduction steps (3, 11) are sufficiently lubricated. The wheel bearing (13) is located radially outside but axially in the area of the first reduction step (3). Hereby is created in axial direction a very compact final drive characterized by favorable degree of efficiently and by being easy to service.

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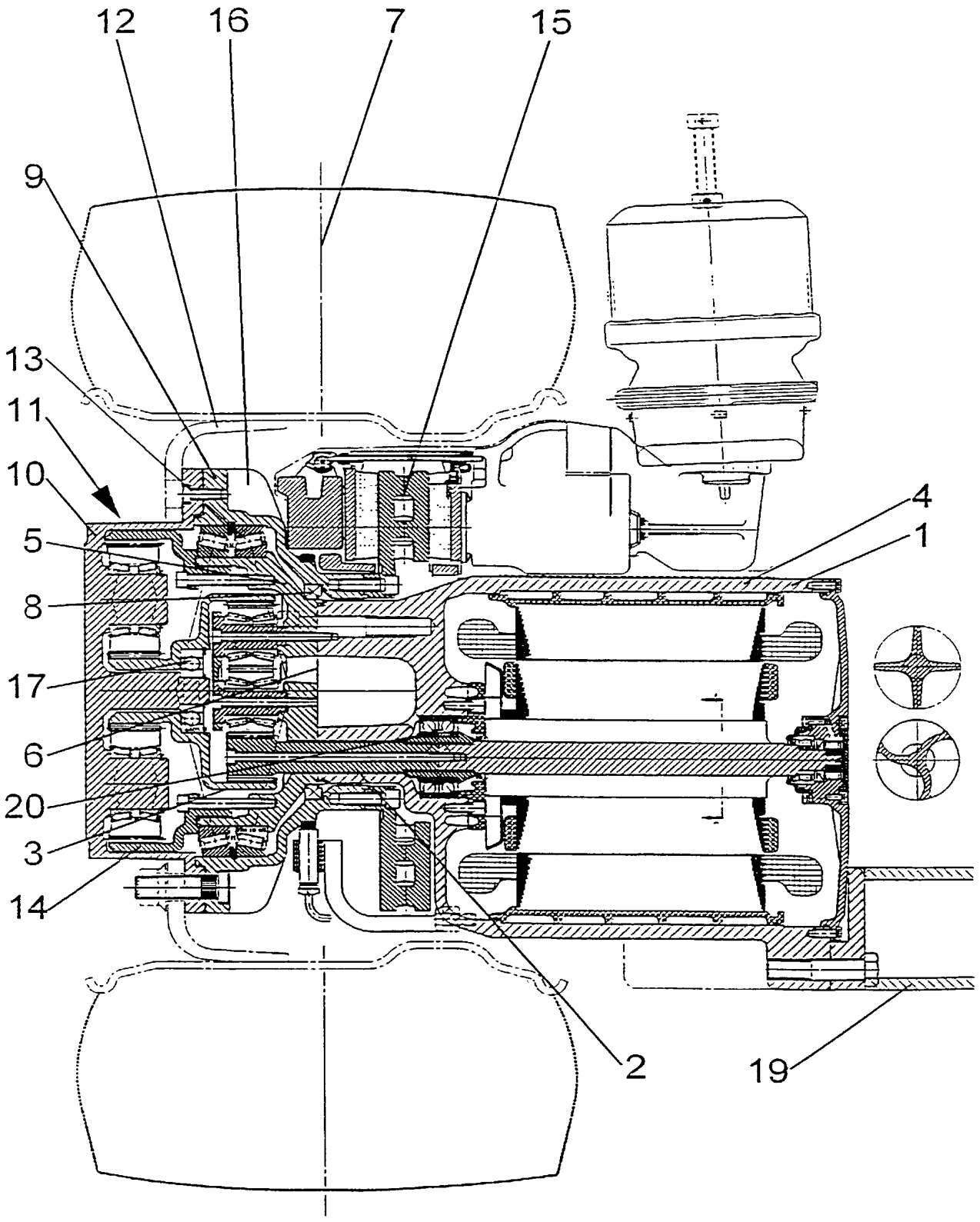

Fig. 1

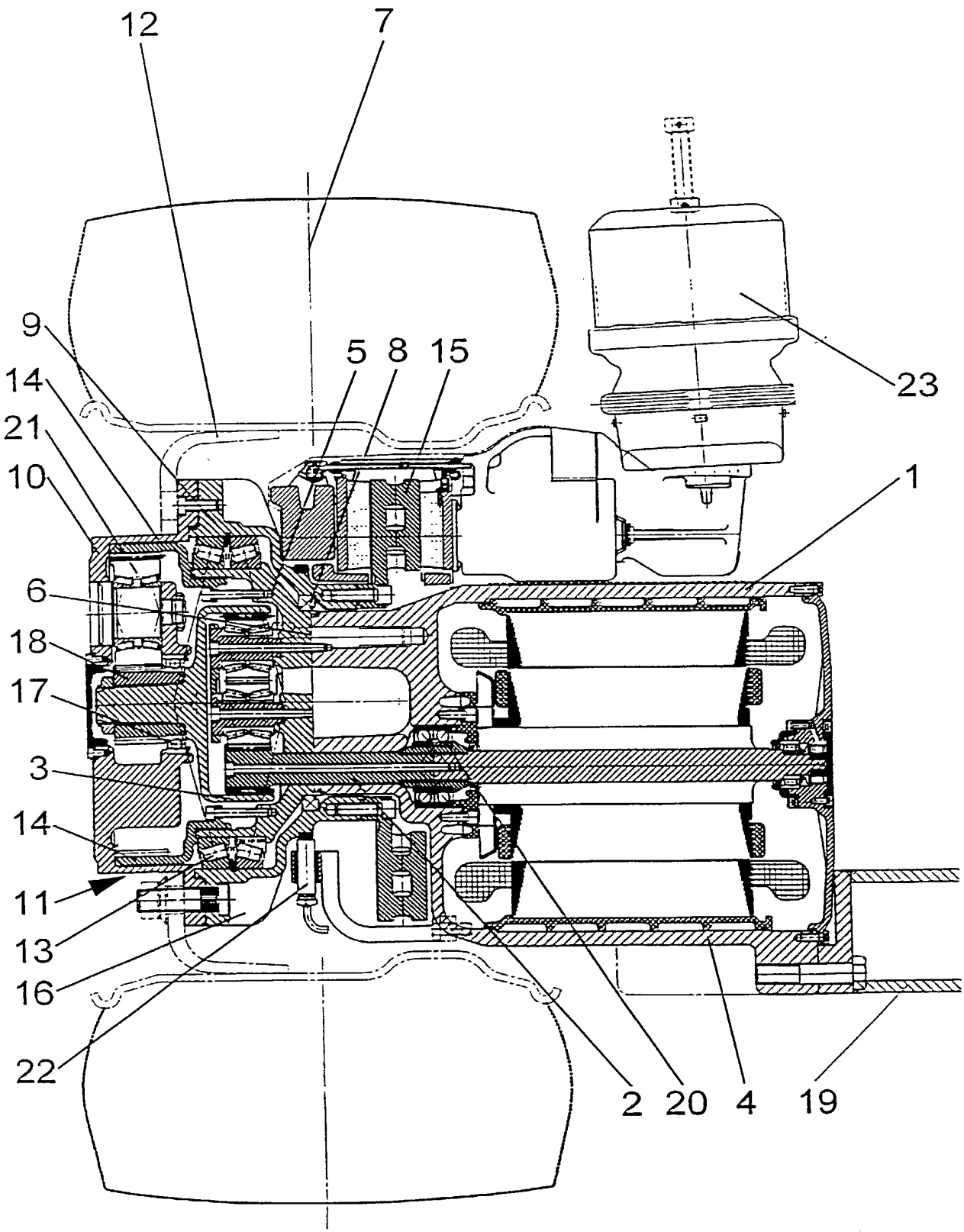

Fig. 2

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COMBINED DECLARATION AND POWER OF ATTORNEY
(Original, Design, National Stage of PCT, Supplemental)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

original
design
supplemental
X National Stage of PCT
divisional (see added page)
continuation (see added page)
continuation-in-part (see added page)

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below next to my name. I believe that the original, first and sole inventor *(if only one name is listed below)* an original, first and joint inventors *(if plural names are listed below)* of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

FINAL DRIVE FOR DRIVING A VEHICLE WHEEL

SPECIFICATION IDENTIFICATION

The specification of which: (complete (a), (b) or (c))

(a) is attached hereto.

(b) was filed on _____ as " Serial No. 0 / _____ or " Express Mail No. _____ (as Serial No. not yet known)_____ and was amended on _____(if applicable).

(c) X was described and claimed in PCT International Application No. **PCT/EP00/09067** filed on **16 September 2000 (16.09.2000)** and as amended under PCT Article 19 on _____ (if any).

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name(s) and registration number(s)) 3

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Attached as part of this Declaration and Power of Attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

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ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to be material to patentability of this application as defined in § 1.56 of Title 37 of the Code of Federal Regulations.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NO.	DATE OF FILING (day,month,year)	PRIORITY CLAIMED UNDER 37 USC 119
Fed. Rep. of Germany	**199 45 345.4**	**(22.09.99) 22 September 1999**	☒ YES NO
			YES NO
			YES NO
			YES NO
			YES NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

1-00

Full name of **sole** ~~joint~~ inventor **Max BACHMANN**

Inventor's signature Max Bachmann Date 11.01.2000

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